

Structural Characteristics of a G+14 Precast Building with Floating Columns and Transfer Girders under Seismic Loading

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Abstract: Floating columns are commonly introduced in multistorey buildings to accommodate architectural requirements such as parking areas, entrance halls, commercial spaces, and conference rooms. However, discontinuity in the vertical load-transfer path can adversely affect the seismic performance of a building. This study investigates the structural response of a G+14 multistorey building with floating columns and transfer girders under seismic loading. Five analytical configurations were considered: a regular building without floating columns, a building with floating columns, a building with floating columns located at the eleventh storey, a building with floating columns and shear walls, and a building with floating columns with modified column dimensions. The models were developed and analyzed using Autodesk Robot Structural Analysis Professional 2016. The response-spectrum method was used to evaluate base shear, storey displacement, storey drift, and fundamental natural period. The results indicate that introducing floating columns increases lateral displacement, storey drift, and the fundamental time period, while slightly reducing base shear because of the reduction in structural mass. The maximum roof displacement increased from 2.9 cm for the regular building to 4.3 cm when floating columns were introduced at the lower level. The corresponding fundamental period increased from 3.02 s to 3.24 s. The provision of shear walls substantially improved the structural response, reducing the roof displacement to 1.7 cm and the fundamental period to 2.48 s. The findings indicate that floating columns should be avoided in high-seismic regions unless suitable lateral-load-resisting systems, such as shear walls, are provided.

Keywords: Floating Column, Transfer Girder, Precast Building, Seismic Analysis, Storey Drift, Storey Displacement, Shear Wall.

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I. INTRODUCTION

Modern multistorey buildings frequently require open spaces at lower or intermediate levels for parking, commercial activities, entrance lobbies, and public facilities. These architectural requirements can result in the termination of columns at an upper or lower floor, causing the supported column to rest on a transfer girder or deep beam. Such a member is commonly referred to as a floating, planted, or stub column.

A floating column does not transfer its load directly to the foundation. Instead, its load is transferred to a beam, which then transfers the load to the columns and foundations below. Although this arrangement may be satisfactory under gravity loading, it produces a discontinuity in the vertical load path and increases the vulnerability of the structure under earthquake loading. Lateral seismic forces must be transferred through the discontinuous floor and supporting girder, leading to increased shear, bending moment, torsion, displacement, and drift.

The seismic performance of a building depends significantly on its structural configuration, stiffness distribution, mass distribution, and continuity of load transfer. A deviation in the shortest load path may cause stress concentration at the transfer level and may result in undesirable structural behavior. Therefore, the use of floating columns in high-seismic regions requires careful evaluation and appropriate strengthening measures.

This study examines the behavior of a G+14 multistorey building with floating columns and transfer girders. The effects of floating-column location, shear-wall provision, and changes in column dimensions are investigated using response-spectrum analysis.

II. OBJECTIVES

The objectives of this study are:

- To investigate the seismic response of a G+14 building with and without floating columns.

- To evaluate the effect of floating-column location on structural response.
- To study the influence of shear walls on buildings containing floating columns.
- To examine the effect of increasing column dimensions.
- To compare base shear, storey displacement, storey drift, and fundamental natural period for the different structural configurations.

III. METHODOLOGY

➤ Building Model

A fifteen-level building consisting of a ground floor and fourteen upper storeys was selected for analysis. The building dimensions were 34.5 X 21 m, and the storey height was 3 m.

Table 1 The Principal Modelling Parameters

Parameter	Value
Building configuration	G+14
Building plan	34.5 m × 21 m
Storey height	3 m
Beam size	250 mm × 450 mm
Normal column size	300 mm × 600 mm
Shear-wall thickness	200 mm
Slab thickness	130 mm
Concrete grade	M25
Reinforcement steel	Fe415
Concrete density	25 kN/m ³
Masonry density	18 kN/m ³
Live load	3 kN/m ²
Seismic zone	Zone V
Importance factor	1
Response reduction factor	5

➤ Analysis Software and Loading

The building models were developed using Autodesk Robot Structural Analysis Professional 2016. The structural members were defined by assigning material properties, cross-sectional dimensions, supports, joints, load cases, and load combinations. The base of the building was assumed to be fixed, and rigid joints were used in the analytical models.

Seismic response was evaluated using response-spectrum analysis in accordance with the applicable provisions of IS 1893.

The principal response parameters were:

- Base shear in the X and Y directions.
- Storey displacement.

- Storey drift.
- Fundamental natural period.

➤ Analytical Cases

Five structural configurations were considered:

- Model 1: Regular building without floating columns.
- Model 2: Building with floating columns at the lower level.
- Model 3: Building with floating columns at the eleventh storey.
- Model 4: Building with floating columns and shear walls.
- Model 5: Building with floating columns and increased column dimensions.

IV. RESULTS AND DISCUSSION

➤ Base Shear

Table 2 The Calculated Base-Shear Values

Structural Model	Base Shear X (kN)	Base Shear Y (kN)
Regular building	791.00	590.00
Floating columns at lower level	772.26	557.85
Floating columns at 11th storey	783.34	581.23
Floating columns with shear walls	1157.00	953.00
Floating columns with modified column dimensions	832.94	637.66

The lower-level floating-column model produced a smaller base shear than the regular building. This reduction is associated with the reduction in structural mass caused by the discontinuation of columns. However, a lower base shear

does not necessarily indicate improved seismic safety. The model with shear walls produced a substantially higher base shear because of its increased lateral stiffness and mass participation.

➤ Storey Displacement

For the regular building, the displacement at the fifteenth storey was 2.9 cm. When floating columns were introduced at the lower level, the displacement increased to 4.3 cm. This represents an increase of approximately 48% compared with the regular model.

When the floating columns were placed at the eleventh storey, the top-storey displacement was approximately 3.0 cm. This result indicates that the location of the discontinuity significantly affects the response. The effect of floating columns at the lower level was more severe than that of floating columns at the upper level.

The shear-wall configuration reduced the top-storey displacement to 1.7 cm, demonstrating the effectiveness of shear walls in controlling lateral deformation. The modified-

column configuration reduced the top-storey displacement to approximately 2.7 cm.

➤ Storey Drift

The maximum reported storey drift for the regular building was approximately 0.2 cm. With floating columns at the lower level, the maximum drift increased to approximately 0.3 cm, particularly near the middle storeys. This increase indicates a concentration of lateral deformation caused by the discontinuous load-transfer system.

The shear-wall model reduced the drift to approximately 0.1 cm in most storeys. Increasing the column dimensions also improved the response, although its effect was less significant than that of the shear walls.

➤ Fundamental Natural Period

Table 3 The Fundamental Natural Periods Obtained for the Principal Models

Structural Model	Fundamental Period (s)
Regular building	3.02
Floating columns at lower level	3.24
Floating columns at 11th storey	3.03
Floating columns with shear walls	2.48
Floating columns with modified column dimensions	2.94

The lower-level floating-column model had the largest fundamental period, indicating reduced global stiffness. The shear-wall model had the shortest period because the shear walls considerably increased lateral stiffness.

V. CONCLUSIONS

Based on the analytical results, the following conclusions were obtained:

- Floating columns produce a discontinuity in the vertical load path and adversely affect the seismic behavior of a multistorey building.
- The introduction of floating columns at the lower level increased the top-storey displacement from 2.9 cm to 4.3 cm.
- The maximum storey drift increased from approximately 0.2 cm for the regular building to 0.3 cm for the lower-level floating-column model.
- The fundamental natural period increased from 3.02 s to 3.24 s when floating columns were introduced at the lower level.
- Floating columns placed at the eleventh storey produced a smaller change in top-storey displacement than floating columns placed at the lower level.
- The provision of shear walls significantly improved the seismic response. The top-storey displacement decreased to 1.7 cm, and the fundamental period decreased to 2.48 s.
- Increasing the column dimensions improved the response moderately, reducing the top-storey displacement to approximately 2.7 cm and the fundamental period to 2.94 s.

- A lower base shear resulting from reduced structural mass should not be interpreted as improved safety because floating columns increase deformation and create discontinuities in the load-transfer mechanism.
- Floating columns should be avoided in high-seismic regions wherever possible. If architectural requirements make them unavoidable, shear walls or another suitable lateral-load-resisting system should be provided and the transfer girder should be designed for the associated forces.

➤ Scope for Future Research

Future studies may investigate:

- Nonlinear pushover and time-history analysis.
- The influence of bracing systems.
- Different shear-wall locations and configurations.
- Transfer-girder design forces and reinforcement requirements.
- Soil–structure interaction.
- Effect of masonry infill and precast connection behavior.
- Experimental validation of floating-column and transfer-girder systems.
- Ductility, stiffness degradation, and energy-dissipation characteristics.

REFERENCES

- [1]. Danish, M. J. "Static and Dynamic Analysis of Multi-Storey Building with the Effect of Ground and Intermediate Soft Storey Having Floating Columns." International Journal for Scientific Research and Development.

- [2]. Gaddad, K., and Vijapur, V. “Comparative Study of Multi-Storey Building with and without Floating Columns and Shear Walls.” *International Research Journal of Engineering and Technology.
- [3]. Kini, V., and Rajeeva, S. V. “Seismic Behavior of RC and Steel-Concrete Composite Multi-Storey Building with Floating Columns with and without Shear Walls.” *International Journal of Research in Engineering and Technology.
- [4]. Meghana, B. S., and Sadashiva Murthy, T. H. “Effect of Floating Column on the Behavior of Composite Multistoried Building Subjected to Seismic Load.” *International Research Journal of Engineering and Technology*, 2016.
- [5]. Pandey, G., and Jamle, S. “Optimum Location of Floating Column in Multistorey Building with Seismic Loading.” *International Research Journal of Engineering and Technology*, 2018.
- [6]. Rohilla, I., Gupta, S. M., and Saini, B. “Seismic Response of Multi-Storey Irregular Building with Floating Column,” 2015.
- [7]. Shrivastava, A., and Patidar, A. “Seismic Analysis of Multistorey Buildings Having Floating Columns.” *SSRG International Journal of Civil Engineering*, 2018.
- [8]. Ullas, G. D., Annapurna, B. P., and Gopal, D. J. “Analysis of Multi Storied Infilled Frame with Floating Column.” *International Journal of Research and Analytical Reviews*, 2019.
- [9]. Wahidi, A., and Seshu, D. R. “Seismic Analysis of Multistorey Building with Floating Columns.” *Asian Journal of Civil Engineering*, vol. 17, no. 8, 2016, pp. 1077–1085.
- [10]. Yadav, S., and Parolkar, R. “Seismic Behaviour of Multistorey Buildings Having Floating Columns.” *International Journal of Civil and Structural Engineering Research*.